UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/614,784	07/12/2000	Srinivas Kandala	TAL 7146.075	2544

7590 07/01/2004

Chernoff Vilhauer McClung & Stenzel
1600 ODS Tower
601 SW Second Avenue
Portland, OR 97204

EXAMINER	
PERILLA, JASON M	
ART UNIT	PAPER NUMBER
2634	8

DATE MAILED: 07/01/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/614,784	KANDALA ET AL.	
	Examiner	Art Unit	
	Jason M Perilla	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 22 April 2004.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-25 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-25 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 12 July 2000 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-25 are pending in the instant application.

Claim Objections

2. Regarding claim 1, "said bits" of line 6, "said bit" of line 9, and "said demodulated signal" of line 9 are lacking antecedent basis in the claim.

Response to Arguments/Amendments

3. Applicant's arguments filed April 22, 2004 have been fully considered but they are not persuasive. The Applicant has made amendments to the claims which are addressed below in the prior art rejections.

Regarding the Applicant's arguments related to a "measure of the center of gravity", the Examiner asserts that the prior art reference Harada et al (US 6115435) indeed clearly discloses a "measure" of the center of gravity. For instance, according to figure 5 and the associated discussion on column 4 lines 2-11, there is a "measure" of the center of gravity used in the bit decisions. The specification of Harada et al discloses that according to the position of the demodulated multilevel signal (signal a), the reliability measure for bit y1 is 2 and the reliability measure for bit y0 is 6. These values are known by the system of Harada et al to have a position ***with respect to the center of gravity*** as shown in figure 5. The system inherently uses the reliability measures in reference to the center of gravity (approx. [4, 4] in figure 5) of the constellation vector pair or pairs to demodulate the signals into bit decisions. *Because the center of gravity [4, 4] divides the constellation area into separate areas whereby proximity is closer to one constellation vector respective to another constellation vector,*

there is a measure of the center of gravity used in the derivation of the reliability measure. Therefore, it is inherent, according to the figures and disclosure of Harada et al, that a measure of the center of gravity must necessarily be attributed in the definition of the reliability measure.

Regarding the Applicant's arguments over the prior art rejection of claims 23-25 as being anticipated by Viterbi et al, it is noted by the Examiner that the Applicant did not properly respond to the art rejection set forth in the first office action. The Applicant merely stated that the prior art reference did not meet the limitations of the claims because it failed to show the limitations of the claims. No discussion was presented by the Applicant regarding why or how the prior art reference et al did not anticipate the claim limitations.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-16 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Harada et al (6115435).

Regarding claim 1, Harada et al discloses a method of demodulating a multilevel signal comprising the steps of assigning values to bits representing a multilevel demodulated signal, identifying at least two signal constellation vectors proximate to said multilevel signal if said bits occupy bit positions corresponding to a pair of bit positions of said at least two constellation vectors occupied by bits of non-varying values, and determining a reliability measure for at least one other said bit of said demodulated signal if said at least one other said bit occupies a bit position of said at least two constellation vectors occupied by a bit of a varying value, wherein said reliability measure is based upon a measure of the center of gravity of said two signal constellation vectors. Harada et al discloses a method of demodulating multilevel QAM signals (fig. 4; col. 1, line 55). Values are assigned to bits representing the demodulated signal (fig. 4, ref. a-c) according to the non-varying points of the constellation vectors (col. 4, lines 4-7), and measures of reliability are made for the varying points of the constellation vectors (col. 4, lines 7-11). At least one (four in the case of signal point "a" of figure 4 – shown in detail in figure 5) signal constellation vectors proximate to the multilevel signal are identified, and a reliability measure of the demodulated bit is found for the bits of varying points among the constellation vectors. Note the constellation vectors of signal "a" in figure 4 referenced by their four bit binary values (ref. "0010", "0000", "0011, and "0001"). A reliability measure is taken depending on the neighborhood that the demodulated bit occupies (col. 1, line 48; col. 3, line 63). For instance, according to figure 5 and the associated discussion on column 4 lines 2-11, there is a "measure" of the center of gravity used in the bit decisions. The identified

at least two (four in the example of signal point "a") constellation vectors proximate to signal "a" of figure 5 are constellations "0010", "0000", "0011, and "0001", and the bits of non-varying values are bits y2 and y3 (the two MSB's). The specification of Harada et al discloses that according to the position of the demodulated multilevel signal (signal "a"), the reliability measure for bit y1 is 2 and the reliability measure for bit y0 is 6.

Regarding claim 2, Harada et al discloses the limitations of claim 1 as applied above. Further, Harada et al discloses the step of identifying at least one signal constellation vector proximate to said multilevel signal comprising the steps of determining a first and second phase component of the multilevel signal, identifying a constellation vector having a first and a second phase component of maximized absolute value but not exceeding an absolute value of the components of the multilevel signal, identifying any constellation vector having one phase component of maximized value but not exceeding the value of the corresponding component of the multilevel signal and another phase component of minimized absolute value but not less that the corresponding component of the multilevel signal, and identifying any constellation vector having phase components of minimized absolute value but not less than the corresponding components of the multilevel signal. Note the several neighborhoods (ref. A-Y) that may are shown in figure 4 depending on the bit representing the multilevel signal and the constellation vectors (ref. "1000", "1010",...). The appropriate constellation vector(s) and neighborhood are identified by determining the phase components of the bit representing the multilevel signal (ref. a-c), and then choosing the constellation vectors according to the bit as described by the limitations of the claim

above and shown in figure 4. A description of the choice of the constellation vectors is provided (col. 3, line 62).

Regarding claim 3, Harada et al discloses the limitations of claims 1 and 2 as applied above. Harada et al also discloses the method of claim 2 further comprising the step of identifying a center of gravity equal distant from the proximate constellation vectors and having first and second center of gravity phase coordinates. Figures 5-7 show the identification of a different center of gravity for various neighborhoods. Figure 5 shows a center of gravity having first and second phase coordinates (intersection of soft decision axes) for the neighborhood "I" in Figure 4.

Regarding claim 4, Harada et al has disclosed the limitations of claim 3 as applied above. Harada et al also discloses that the measure of reliability is a function of the difference between at least one of the first and second phase components of a bit representing the multilevel signal and the center of gravity phase coordinates (fig. 5; col. 4, line 3).

Regarding claim 5, Harada et al discloses a method of demodulating a multilevel signal comprising the steps of: identifying a neighborhood of a signal constellation in proximity to said multilevel signal, said neighborhood defined by a set of at least one constellation signal; assigning a hard decision value to a bit of said demodulated signal if it occupies a bit position corresponding to a constant bit value; determining a measure of a center of gravity of said neighborhood; and assigning a value and reliability measure to a demodulated signal bit if it occupies a position having a variable bit value. Figure 4 shows the definitions of various neighborhoods depending on the demodulated

bit. The demodulated signal “a” of figure 4 has a corresponding neighborhood “I” defined by a set of constellation vectors “0010”, “0000”, “0011”, and “0001”. Likewise, the demodulated signal “c” of figure 4 has a corresponding neighborhood “K” defined by a set of constellation vectors “1001”, and “1101”. A hard decision or absolute decision is made for bit(s) of the demodulated signal that are constant for a particular neighborhood. It is recited that the bits “y3” and “y2” of the demodulated signal “a” of figure 4 are found by hard decision to be both “0” (col. 4, line 3). A center of gravity is determined for the neighborhood. For the neighborhood “I” of figure 4, the determined center of gravity is shown in figure 5 (col. 4, line 11). A value and a reliability measure is assigned to the bits of a neighborhood that are of a varying value. For the demodulated signal “a” of figure 4, a reliability measure for bits “y1” and “y0” is obtained for each since the bits are varying within the neighborhood “I” (col. 4, line 7). A value is assigned to any bits of varying values within a neighborhood using the reliability measure (col. 7, line 31).

Regarding claim 6, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure is a function of a relative position of the multilevel signal and a center of gravity of a neighborhood. Figure 5 shows the demodulated signal “a” and the reliability measure being a function of the relative position of the demodulated signal “a” and the center of gravity (intersection of axes) of the neighborhood (col. 4, line 7).

Regarding claim 7, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure is a distance between

a multilevel signal and a center of gravity of a neighborhood (fig. 5; col. 4, line 7). It is inherent that the reliability measure is directly related to a distance between a multilevel signal and a center of gravity of the neighborhood because it is the center of gravity of the neighborhood which the reliability measure is measured against for reliability. *For example, the closer the measure of reliability is according to the center of gravity of the neighborhood, the less "reliable" the measure is.* This is inherent according to the neighborhood figures as shown (figs. 5-7).

Regarding claim 8, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure comprises a difference between a quadrature component of a multilevel signal and a quadrature component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 9, Harada et al discloses the limitations of claim 5 as applied above. Harada et al further discloses that the reliability measure comprises a difference between an in-phase component of a multilevel signal and an in-phase component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 10, Harada et al discloses a method of demodulating a signal comprising: acquiring the multilevel modulated signal; locating said acquired multilevel signal relative to a constellation of signal vectors being represented by a plurality of bits; identifying a plurality of signal vectors defining a neighborhood of the constellation nearest the acquired signal; determining a measure of a center of gravity of the neighborhood; assigning a hard decision value to a bit representing the acquired multilevel signal if a corresponding bit is constant for the signal within the defining

neighborhood; and assigning a soft decision value and a measure of reliability of a bit representing the acquired multilevel signal if a corresponding bit is varying for the signal within the defining neighborhood. Figure 4 shows various acquired multilevel signals (ref. a-c) and it shows a plurality of signal vectors each being represented by a plurality of bits. For instance, the neighborhood "A" of figure 4 is defined by the signal vector represented by the plurality of bits "1000". Figure 4 also shows the identification of a neighborhood ("I") defined by a plurality of signal vectors nearest the acquired signal ("a"). Bit values are defined by a hard decision for any bits of an acquired signal that are constant within a corresponding neighborhood (col. 4, line 3). Bit values and a reliability measure are defined by a soft decision of any bits of an acquired signal that are varying within a corresponding neighborhood (col. 4, line 7; col. 7, line 31). According to figure 5 and the associated discussion on column 4 lines 2-11, there is a "measure" of the center of gravity used in the bit decisions. The identified at least two (four in the example of signal point "a") constellation vectors proximate to signal "a" of figure 5 are constellations "0010", "0000", "0011, and "0001", and the bits of non-varying values are bits y2 and y3 (the two MSB's). The specification of Harada et al discloses that according to the position of the demodulated multilevel signal (signal "a"), the reliability measure for bit y1 is 2 and the reliability measure for bit y0 is 6. *Therefore, the closer the measure of reliability is according to the center of gravity of the neighborhood, the less "reliable" the measure is.* This is inherent according to the neighborhood figures as shown (figs. 5-7).

Regarding claim 11, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses assigning a value to a bit representing an acquired multilevel signal if its corresponding neighborhood is defined by a single vector. The neighborhood "E" of figure 4 is defined by a single vector represented by the bits "0000". Harada et al discloses that an acquired signal that has a corresponding neighborhood represented by "E" of figure 4 would be assigned a bit value "0000" by hard decision (col. 4, line 28).

Regarding claim 12, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses the reliability measure being a function of a relative position of an acquired multilevel signal and the center of gravity of the neighborhood. Figure 5 shows how the reliability measure is a function of the relative position of the acquired signal "a" and the center of gravity (center of axes) and it is also described (col. 4, line 7).

Regarding claim 13, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses the reliability measure being distance between an acquired multilevel signal and the center of gravity of the neighborhood. Figure 5 shows how the reliability measure is a distance between the position of the acquired signal "a" and the center of gravity (center of axes) and it is also described (col. 4, line 7).

Regarding claim 14, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses that the reliability measure comprises a difference between a quadrature component of a multilevel signal and a quadrature component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 15, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further discloses that the reliability measure comprises a difference between an in-phase component of a multilevel signal and an in-phase component of a center of gravity of a neighborhood (fig. 5; col. 4, line 7).

Regarding claim 16, Harada et al discloses the limitations of claim 10 as applied above. Harada et al further shows the constellation of signals vectors in figure 4 ordered according to gray code.

6. Claims 23-25 are rejected under 35 U.S.C. 102(b) as being anticipated by Viterbi et al (IEEE Transactions on communications, Vol. 41, No. 4, April 1993).

Regarding claim 23, Viterbi et al discloses a method of demodulating a multilevel signal comprising limiting a measure of reliability to a predetermined range (pg. 562, col. 2, line 7) and providing a soft decision value to bits of the demodulated signal associated a measure of reliability having values not exceeding a limiting value of the range (pg. 561, col. 2, line 8).

Regarding claim 24, Viterbi et al discloses a method of demodulating a multilevel signal comprising limiting a measure of reliability to a predetermined range and providing a soft decision value to bits of the demodulated signal associated a measure of reliability having values not exceeding a limiting value of the range as applied to claim 23 above. Viterbi et al further discloses the measure of reliability being a log likelihood ratio (pg. 562, col. 1, line 12).

Regarding claim 25, Viterbi et al discloses a method of demodulating a multilevel signal comprising limiting a measure of reliability to a predetermined range and

providing a soft decision value to bits of the demodulated signal associated a measure of reliability having values not exceeding a limiting value of the range as applied to claim 23 above. Viterbi et al further discloses that the limiting range is equivalent to a number of bit demodulated with a soft decision (pg. 562, col. 2, line 7).

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 17-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada et al in view of Viterbi et al.

Regarding claim 17, Harada et al discloses a method of demodulating a multilevel signal using a Viterbi decoder (fig. 14, ref 341; col. 7, line 31). Harada et al does not disclose the Viterbi decoder comparing the reliability of at least two bits of the demodulated signal, assigning a hard decision to a bit associated with a greater reliability, and assigning a soft decision to a bit associated with a lesser reliability. However, Viterbi et al discloses a decoder that compares the reliability of at least two bits, assigns hard decision values to bits associated with greater reliability, and assigns soft decision values to bits associated with lesser reliability depending on their log likelihood ratio (pg. 561, col. 1, III. Signal Statistics, Metric Calculation, and Soft Decoder Performance). Therefore, it would have been obvious to one having ordinary

skill in the art at the time the invention was made to utilize the Viterbi decoder of the exemplary description by Viterbi et al for the Viterbi decoder shown by Harada et al.

Regarding claim 18, Harada et al in view of Viterbi et al disclose a method of demodulating a multilevel signal comprising comparing the reliability of at least two bits of the signal, assigning a hard decision value to a bit associated with a greater reliability, and assigning a soft decision value to a bit associated with lesser reliability as applied to claim 17 above. Viterbi et al further discloses that the reliability is measured by a log likelihood ratio (pg. 562, col. 1, line 13).

Regarding claim 19, Harada et al in view of Viterbi et al disclose a method of demodulating a multilevel signal comprising comparing the reliability of at least two bits of the signal, assigning a hard decision value to a bit associated with a greater reliability, and assigning a soft decision value to a bit associated with lesser reliability as applied to claim 17 above. Harada et al further discloses the steps of assigning a soft decision value to bits of the demodulated multilevel signal comprising assigning a value to the bit (col. 7, line 31) and assigning a measure of reliability to the bit (col. 4, line 7).

Regarding claim 20, Harada et al in view of Viterbi et al discloses the limitations of claim 19 as applied above. Further, Viterbi et al discloses that the measure of reliability is a log likelihood ratio (pg. 562, col. 1, line 13).

Regarding claim 21, Harada et al in view of Viterbi et al discloses the limitations of claim 17 as applied above. Viterbi et al further discloses the limiting the measure of reliability to a predetermined range (pg. 562, col. 2, line 7) and providing a soft decision

value to bits of the demodulated multilevel signal associated a measure of reliability having values not exceeding a limiting value of the range (pg. 562, col. 1-2).

Regarding claim 22, Harada et al in view of Viterbi et al discloses the limitations of claim 21 as applied above. Viterbi et al further discloses that the limiting value of the range is equivalent to the number of bits demodulated with a soft decision (pg. 562, col. 2).

Allowable Subject Matter

9. No claims are allowed.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M Perilla whose telephone number is (703) 305-0374. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Chin can be reached on (703) 305-4714. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jason M. Perilla
June 21, 2004

jmp

STEPHEN CHIN
SUPERVISORY PATENT EXAMIN
TECHNOLOGY CENTER 2600